

Data Center Over-Temperature Shutdown System

Project Requirements

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1 Introduction

This document describes the functional requirements for the Fermilab Data Center Over-Temperature Shutdown System (OTSS). This system provides a safety net to protect equipment in the data centers from a premature activation of fire sprinklers due to high temperature caused by insufficient cooling conditions. When triggered by such conditions, the Over-Temperature Shutdown System will cause a main power disconnect for all non-safety related systems in the data centers. Emergency lighting, fire, and security systems are not connected to the Over-Temperature Shutdown System.

2 Requirements

This section describes OTSS requirements necessary to achieve the goal of protecting equipment in the data centers from water damage in the event of an insufficient cooling condition.

2.1 *Function*

The OTSS must turn off all major power consumers in the data center when the temperature in the room reaches a preset limit. This limit is to be adjustable within the range of 30°C and 70°C. The OTSS must generate a power off trip within 15 seconds of the measured room temperature exceeding the trip set point. The system must be designed to minimize nuisance trips to every extent possible.

2.2 *Reliability*

2.2.1 **Redundancy**

Due to the critical nature of the system, the OTSS will consist of three independent sub-systems, consisting of a primary system and two backup systems. Each system is capable of providing the same over-temperature shutdown functionality, but will be set to trip at progressively higher temperatures. Each of the three systems will be designed and implemented such that they share as few components and design elements as possible to minimize the chance of a design flaw or a component failure causing a catastrophic over-temperature failure. Each of the three sub-systems will be powered by a dedicated independent electrical circuit. These circuits will power no other devices, and will be fed by an Uninterruptable Power Supply (UPS).

The primary OTSS sub-system will be set to trip at the lowest temperature of the three sub-systems. It will use an array of temperature sensors placed on a grid with a grid spacing of no more than 10 feet in distance. Additional sensors may be used to monitor additional areas as deemed necessary. An over-temperature trip condition may only be generated if two or more sensors exceed the trip set point.

The secondary and tertiary sub-systems will be set to sequentially higher trip temperatures, with the secondary sub-system set to a lower temperature than the tertiary, and a higher temperature than the primary. Both secondary and tertiary sub-systems must use at least three temperature sensors spaced

widely, and near high heat areas in the computer room. An over-temperature trip condition may only be generated if two or more sensors exceed the trip set point.

2.2.2 Low-Stress Design

System design and implementation practices must be employed to minimize component stress that would adversely affect reliability.

2.2.3 High Reliability Components

High Reliability components will be used for all components considered critical to the reliable operation of the shutdown system.

2.2.4 System Simplicity

Excess complication in the critical areas of the design will be avoided wherever possible.

2.3 Fail-Safe Design

Each of the three OTSS sub-systems will be designed to fail in the power on mode to minimize data center down time. This failure mode can be tolerated in this case due to the two backup systems in place. Regular system testing will reveal system failures that require repair.

2.4 Testability

Each of the three independent OTSS sub-systems must be testable without actually disconnecting power from the data center. A system test procedure will be developed and documented. The system design and test procedure will stress avoidance of accidental data center shutdown during system testing.

2.5 Monitoring

Measured temperatures and other system status information generated by the OTSS system must be monitorable remotely through Sitescan, and locally through a display in each data center room. OTSS will flag errors if sensors report a temperature below 10°C. Sitescan will be programmed to set an overtemp alarm if any OTSS sensor reports an overtemp condition.

2.6 Power Requirements

Each sub-system of the OTSS will be powered by a dedicated 110VAC 60Hz circuit that is supplied by a UPS. No other loads will be allowed on these circuits.

2.7 Connectivity Requirements

2.7.1 Emergency Power Off System

Each OTSS sub-system must independently interface with the Emergency Power Off system in each computer room in order to disable computer room power when an over-temperature condition exists. These connections and the OTSS must not interfere with the normal operation of the Emergency Power Off system.

2.7.2 Remote Monitoring System

Each OTSS sub-system must interface with the SiteScan monitoring system. The OTSS will provide temperature readings and other status information to SiteScan.

2.8 Displays

The OTSS will provide a system display panel in each computer room. Sensor temperatures and related status information will be clearly displayed.

2.9 Maintainability

The OTSS will be designed with a minimum design life of 10 years. Commercially available components will be used wherever possible, and sufficient spare parts will be procured at installation time. System components will each be analyzed for criticality to the functioning of the system, and high reliability components will be used where needed.

A system testing procedure will be developed by the system designers and executed on a regular schedule by data center operations personnel.

2.10 Safety

For 110 VAC (and higher) circuits, the safety requirements for high voltage power distribution systems must be followed. These are detailed in the Fermilab ES&H Manual, Occupational Safety And Health section on Electrical Safety which can be accessed at:

www-esh.fnal.gov/FESHM/5000/5046.html

A hazard analysis sheet must be completed and signed by any person who will be working with any high-voltage system, circuit board, or other electronic device. The internal wiring of a commercially manufactured piece of equipment is exempt as detailed in the FESHM section reference above. The reference provides guidance on load connections, ribbon cables, multiple conductors and mechanical components.

2.11 Dependence

The purpose of the OTSS is limited to the prevention of material and financial losses due to temperature related property damage. The safety of personnel cannot rely on the OTSS. Fire detection/protection, emergency lighting, security systems, and all other personal safety systems are not controlled by or connected to the OTSS.